BIOMECHANICAL AND ELECTROMYOGRAPHICAL ANALYSIS OF BACKHAND OVERHEAD STROKES PERFORMANCE OF MALE BADMINTON PLAYER

BY

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A SYNOPSIS

Submitted to

Lakshmibai National Institute of Physical Education

Gwalior(M.P.)

For the degree of Doctor of Philosophy in Physical Education

(July 2021)

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CHAPTER-1

INTRODUCTION

The participants achieving success nowadays in professional sports is influenced by insights from various disciplines. Besides having a good physique, professional training includes technical and tactical preparation with more emphasis given to the development of various basic skills that plays a vital role in whole game play. Professional trainers believe that the total performance capacity of a sportsperson is multidimensional, in short, they suggest that the overall Gameplay of a player is a total sum of basic and advanced skills. Thus, excelling in Sports has become a highly technical job. Sports federations are also promoting different aspects of sports performance based on scientific studies. As a result, new techniques and methods are being adopted by athletes, coaches and trainers for achieving higher levels of sports performance. Biomechanics is one of that tool which analyse any skill, refine it and helps other to understand it in better way. One of the definitions was given in the Book of Hay's (1973) definition of biomechanics "Biomechanics is the science that examines forces acting upon and within biological structure and effects produced by such forces.

In Sports Biomechanics laws of Biomechanics are applied in human movement to achieve the highest performance. Biomechanics helps in reducing athletic injuries. To understand the mechanical movement, it applies mechanical physics and scientific principle such as computer movement (numerical movement), electrical engineering (Digital filtering), Gait analysis (Force platforms) and clinical neurophysiology (Surface EMG) (Alexander, 2005)

There are many biomechanical measurements that can be made through video analysis. For speed measurement once need to have video from directly side on, calibration is done before the video is taken. And once need to know the fame rate of the video. The speed of an object measured through how it moved in given time. Frame rate may vary from 25

frames per second to 1000 frames per second or high more. To calculate accurate measurement of video footage once need to have collected video in correct manner. During collection of video once should give important o placement of camera. Camera should be directly side of the individual where the performance is executed. Choose the multiple angles to get the best views. Camera should be steady better not to hold the camera in hands once should set up the camera in tripod. Zoom function should not use during recording. Once must use calibration to measure the position of the object. Video has lot of contribution to sports and science. Coaches and athlete used many video techniques to analyse video performance. Video analysis software is also used in gait analysis, injury rehabilitation, and biomechanical research. Through biomechanical analysis has the ability to rectify the error, game high light can be generated (Robertson, Caldwell, Hamill, & Kamen, 2014)

Electromyography is the electro diagnostic study of muscles and nerves. The test includes two components: Nerve conduction studies (NCS) and electromyogram (EMG). Nerve conduction studies measure how well and how fast the nerves can send electrical signals. Nerve conduction studies provide unique quantitative information about neurological function. EMG is a seductive muse because it provides easy access to physiological processes that cause the muscle to generate force, produce movement, and accomplish the countless functions that allow us to interact with the world around us. The current state of surface EMG is enigmatic. It provides many important and useful applications. EMG is commonly used to measure the level of muscle activation and provides a rough estimate of exercise intensity for specific muscles involved in the movement. EMG signal has many contributions for finding the human body muscle functions. EMG is the recording of the electrical activity of muscles, and therefore constitutes an extension of the physical exploration and testing of the integrity of the motor system. Electromyographic analysis can provide information as to the relative amount of muscular activity an exercise requires, as well as the optimal positioning for the exercise. Electro- physiological techniques enable us to relatively easily obtain very valuable information about neuromuscular activity.[1]

Badminton is the one of the fast growing and popular sports Globally. It is one of the fast moving game that can play by every age group. The sport is popular in Elders in term of fitness because it helps in burning more calorie and maintain fitness as well. The purpose of the games is to place the shuttle in opponent court where the opponent faces the difficulty to lift the shuttle that is why corners of the opponent is best choice for the opponent which is

[1] Hande Türker and Hasan Sözen ,http://dx.doi.org/10.5772/56167

furthest point from player. Badminton Games take years of training to learn difficult movement of Badminton Hence Sports man need to learn the skill systematically and correctly right from start to stroke (Brahms, 2010) When we said we have to learn the skill systematically and correctly from the beginning of learning any game it is became more important to learn and execute basic skill in correct way because good basic is the most important thing to enhance your game plan. Think of serving in badminton as similar to being a broker in the stock market. A good stockbroker will provide good advice, and you will receive good returns on your investments. In badminton, good serves give you a better opportunity for success or to score points and win games. In order for your serve to be legal, you must make contact with the shuttle below your waist and the racket shaft must point downward. Your entire racket head must be discernibly below any part of your racket hand before striking the shuttle. The underhand serve puts the shuttle in play at the beginning of each rally and, therefore, is probably the most important single stroke. It is difficult to score consistently without an adequate serve. Also, players often use this stroke to set up a practice partner for practicing strokes or drills. In badminton we can see a changes in technique and their adaptation, even though we see the changing form of mixed doubles where previously people considered it as a man dominating role and they take woman player as a support this trend is changing too, now woman plays the equal role in it.

While we are taking science into improving the major skill then that is become important to know the actual characteristic of the skill. Backhand is one of the most technical skill of the badminton that need a proper execution and it is still hard to learn for beginners. The applied force, angle of execution shifting the weight, point of contact and follow through that all are play vital role in execution a proper backhand strokes. The aim of the backhand is to use your optimum energy to execute the skill from your odd side or non-dominating side, if a player doesn't use the proper technique then there is chances to loose point or a poor return. The backhand is always the second best option from the back boundary line (as an overhand shot), and the forehand should be played whenever possible (left-of-head shot). The backhand has less precision and power, although the backhand clear, smash and drop are among the most technically demanding shots in badminton. The backhand can be very effective in the front of the court as a defensive shot, when the player is standing either in the center of the court or lunges to the net

The backhand overhead stroke allows you to return your opponent's shots from your backhand side even when they are completely behind you. With the proper footwork and stroking technique, your backhand saves you time and energy and can produce effective offensive or defensive shots. When the shuttle is hit to your backhand side during a rally, you should move into a position behind the oncoming shuttle and assume your backhand grip. If you are returning with a backhand overhead clear, turn your shoulders and pivot at your waist to get sideways to the net. As the shuttle drops in the hitting area, swing your racket upward with the elbow leading the hand up to contact with the shuttle. Contact the shuttle in front of your body and as high as possible with the racket finishing in the direction of the shuttle's trajectory. The racket face is angled upward, directing the shuttle high and deep. The defensive clear is directed upward, high over your opponent's head. The offensive clear is hit in a flat, fast trajectory, just out of your opponent's reach. Your hand and wrist allow your racket arm to follow through naturally. Rapid forearm supination provides the majority of the power. Your racket travels through the contact area and then forward in line with the flight of the shuttle. At or very soon after contact on the backhand overhead, transfer your body weight rapidly as your feet push your body back toward midcourt.

In all the three backhand stroke either it is clear, smash and drop, it requires more technical knowledge than forehand. The backhand smash need even more power than forehand smash. This really help in making a game plan stronger if this area is strong. As badminton is the game of quick change in movement and as well as direction and grip, you have to change the grip. The advance level player using Danish grip nowadays. In the other way when we are talking about backhand drop shot it is one of the most delicate strokes in badminton that make move your opponent in front court.

Statement of the problem

The problem is entitled as Biomechanical and Electromyographical Analysis of Backhand Overhead Strokes Performance of Male Badminton Player.

Objective of the Study

There are following objectives of the study:

1. To Characterize the level of maximum muscle activation of selected muscle during execution of badminton backhand drop, backhand smash, backhand clear.

2. To find of the correlation between kinematical and Electromyographical Variables with performance of the backhand Drop shot, Backhand Smash and backhand overhead clear.
3. To study the joint contribution of Selected Kinematics and Electromyographical variables on performance of the Backhand Drop shot, Backhand smash, Backhand overhead clear.
4. To find out the Individual Contribution of Kinematical and Electromyographical variable and performance of the Backhand overhead clear.

DELIMITATION

1. The study will be confine to University Level male badminton players of Gwalior.
2. The study will be delimited to players age ranging 17-25 years.
3. The study will delimit to 10 badminton player.
4. The study is delimiting to right handed badminton player only.
5. The study will delimit to Selected skill of badminton that is,
    - Backhand Overhead Clear,
    - Backhand Overhead Drop,
    - Backhand Overhead Smash.
6. The study is delimited to following kinematic variables
    1. Angle of Right ankle joint,
    2. Angle of Right knee joint,
    3. Angle of Right hip joint,
    4. Angle of Right shoulder joint,
    5. Angle of Right elbow joint,
    6. Angle of Right wrist joint.
5. Linear kinematic variables during the skill
    1. Racket velocity,
    2. Shuttle Velocity.
6. The EMG Variables are,
    - Branchioradialis,
    - Triceps,
    - Biceps,
    - Posterior Deltoid

LIMITATION

- Subjects personal Habits including stress and strain, Emotional state of mind and other factor which might affect in result of the study.

- Effect of Psychological and social stress on subject during the time of data collection.

HYPOTHESIS

On the basis of knowledge gained from available literature, research findings and scholar own understanding of the subject area, the following hypothesis is formulated:

- It is hypothesizing that there will be significance relationship among selected kinematic and Electromyographical variables during execution of three different Backhand overhead badminton strokes
- It is hypothesizing that there will be significant contribution of selected Muscle during execution of different badminton backhand overhead strokes.

Definition of technical terms

Kinematics,

Kinematic is that branch of biomechanics which is concerned with describing the motion of bodies. Thus kinematic deals with such things as how far a body moves, how fast it moves, and how consistently it moves. It is not concerned at all with what causes a body to move the way it does. (Hall, 1995).

Badminton,

Badminton is one of the most popular sports in the world. It appeals to all age groups and various skill levels, and men and women may play it indoors or outdoors for recreation as well as competition. The shuttlecock does not bounce and must be

played in the air, thus making a fast game requiring quick reflexes and some degree of fitness. (Grice Tony, 2008)

Backhand Drop shot:

When the shuttle is hit to your backhand side during a rally, move into position behind the oncoming shuttle and assume a backhand grip. If you are returning with a backhand overhead drop shot, turn your shoulders and pivot at your waist to get sideways to the net

Backhand Smash:

The backhand smash is an advanced skill that requires proper timing, a higher skill level, and good eye–hand coordination. Throw your racket up to meet the shuttle with your elbow leading. Take the overhead backhand smash as high as possible. Your racket head must be moving at a rapid rate as it goes out to meet the shuttle

Backhand Overhead Clear:

The backhand overhead stroke allows you to return your opponent's shots from your backhand side even when they are completely behind you.

Electromyography:

Electromyography is the electro diagnostic study of muscles and nerves. The test Includes two components: Nerve conduction studies (NCS) Surface Electromyography is a non-invasive technique for measuring muscle electrical activity that occurs during muscle contraction and relaxation cycles.

SIGNIFICANCE OF THE STUDY

1. To see the angle of contact while execute Different strokes.
2. The study will help the coaches/professional to understand the badminton player nature of execution the major skills.
3. The study will help in improving technical aspect of game and will help the coaches/player in which way player has to hit the shuttle to get better result
4. This study will provide the mechanical area of movement of human organism, skill technique
5. The study will help coaches to understand progress of player.

6. The study will help in ensuring biomechanical manual or guide for badminton player, and will help new coaches to improving game, recognise mistake and as well as help in planning new training.
7. The study will help players to improve advance in badminton.
8. The study will help players to avoid technical error or fault while executing those skills.

CHAPTER 2

REVIEW OF RELATED LITERATURE

The purpose of this study was to analyse the performance of three different backhand overhead strokes (smash, clear and drop). In this study, we are interested in analyzing the phase of preparation position to the point of making contact with the shuttle. Two Redlake high-speed video cameras operating at 250Hz were simultaneously used to obtain 3-D data. A repeated one-way ANOVA and Pearson product moment correlation were used to test the selected variables at .05 significant levels. It was concluded that increasing the shoulder angle of drop and the wrist angular velocity of smash and clear will increase the shuttle velocity.[2]

The purpose of this study was to analyze the surface EMG activity of the upper limb muscles of Taiwan elite badminton players when they were performing the forehand and the backhand smashes. We used two digital video cameras to obtain the 3D kinematics data of the shuttlecock, and measured the surface EMG signals of seven upper limb muscles. The results showed that there were significant differences between forehand and backhand smashes in the following variables: the initial shuttle velocity, the contact height, the initial flight angle of the shuttle, the sequence of the surface EMG activities of the upper limbs and the mean IEMG amplitude in the selected muscles. The reason why the forehand smash was faster than the backhand smash might be because the up swing displacement and up swing racket velocity of the forehand smash was greater than that of the backhand smash.[3]

Badminton smash is one of the most powerful techniques among all the racket sports. It may divide into smash and jump smash. The purpose of this study was to analyse

[2] Kuei-Shu Huang\ Chenfu Huang\ Shaw Shiun Chang2 , and Chien-Lu Tsai2 1National Taiwan Normal University, Taipei, Taiwan 2National Taiwan Ocean University, Keelung, Taiwan, ISBS 2002

[3] Chien-Lu Tsai, Chan-Chang et al. 2006, TUB1-1: 9:30 - 9:45

the surface EMG activity of upper extremities between smash and jump smash by eight Taiwan elite badminton players. We used two digital video cameras to obtain the 3D kinematics data of shuttlecock, and measured the surface EMG signals of seven upper limb muscles. The results showed that there was no significant difference between the two smashes in initial shuttle velocity. Though the movements of the two smashes were similar, there were significant difference between the two smashes in the sequence of the surface EMG activity of the upper limb and the mean IEMG amplitude in a few muscles. We found that the jump smash exerted the higher EMG activity than smash in the phase before contact point.[4]

The purposes of this study was to analyze the kinematics and electromyographic variables for the backhand clear motion according to the type of hitting in badminton. Ten male university players were selected as the subjects. Four digital video cameras and Noraxon Telemyo 2400 were used to collect the 3D kinematics and electromyographic data. The results were as follows: 1) in the phase of impact, the time of motion for the overhead backhand clear was the longest, 2) in the event of impact, the distance of step toward X direction was the longest and the distance of step toward Y direction was the shortest for the overhead backhand clear, 3) in the event of backswing, the rotation angles of shoulder and pelvis and the flexion angle of shoulder for the overhead backhand clear were the biggest, 4) the maximum flexion angular velocity of shoulder and the maximum extension angular velocity of elbow for the overhead backhand clear were the biggest, and 5) in the phase of impact, mean EMG of the wrist flexor, triceps, and trapezius muscle for the overhead backhand clear was bigger than that for the underhand stroke and in the phase of follow-through, mean EMG of the wrist flexor and extensor, biceps, triceps, and trapezius muscle for the overhead backhand clear was the biggest.[5]

In badminton, it demands excellent physical fitness and good motor coordination for the development of sophisticated racquet movement. This study aims at identifying the difference of forehand and back hand smash performed by elite male badminton players during North-Zone intervarsity at A.M.U, Aligarh 2009-2010. The parameters to study were focused on upper arm, forearm and wrist segments. Silicon Coach Pro-7 motion

[4] Chien-Lu Tsai, Chan-Chang Yang, Mei-Shiu Lin, Kuei-Shu Huang National Taiwan Normal University, Taipei, Chinese Taipei

[5] Kim, Ho-Mook, Korean Journal of Sport Biomechanics,Volume 24 Issue 1.2093-9752(eISS)

analysis software and two legria Canon SF-10 cameras system were used to record and analyze the performance of the subjects. Six male participants served as the subjects. Results of the study shows that there is no significant differences exist between forehand and back hand smash in badminton player as flight angle, shoulder angle, elbow angle and angular velocity of wrist joint. Whereas significance differences exist between forehand and back hand smash in badminton players as shuttle velocity, contact height, racket angle, wrist angle, angular velocity of shoulder joint and elbow joints. Appropriate coaching cues are devised to assist coaches and players in assessing and improving performance.[6]

[6] IkramHussain, 2011 Innovative Systems Design and Engineering www.iiste.org ISSN 2222-1727 (Paper) ISSN 2222-2871 (Online) Vol 2, No 7, 2011

CHAPTER-3

METHODOLOGY

In this chapter the selection of subjects, selection of variables, criterion measures, reliability of the data, administration of test, and collection of data, the techniques employed for analysis is describe.

Selection of subjects

For the purpose of the study, total 10 male Badminton player from Gwalior will be selected who participated at least in interuniversity games with the age ranging from 17- 25 years of old with the minimum 3-year experience.

Selection of variables

Based on literature evidence, correspondence with the expert and scholar's own understanding and keeping feasibility criterion in mind, the researcher selected following biomechanical (kinematical) variables for the present study:

(A) Angular kinematic variable of selected strokes

- Angle of the Right shoulder joint,
- Angle of the Right elbow joint,
- Angle of Right wrist joint,
- Angle of right hip joint,
- Angle of right Knee Joint,
- Angle of Right ankle joint,
- Angle of Right wrist joint.

(B) Linear kinematic variables of Different strokes:

- Velocity of the shuttle,
- Velocity of the Racket

(C). Electromyographical Analysis site

- Branchioradialis
- Triceps
- Biceps
- Posterior Deltoid

Procedure for collection of data

Videography will be used in the study. Selected kinematics variables at the phase of point of contact will analyse. These selected phases of the skill will get from the videography and the put it on software Kenova 0.8.27 which developed the stick figure of selected phases of the skill from which selected biomechanical variables will obtain. Muscles activities during skill execution of selected games will measure by EMG using Bio Tech Thought Technology of eight channels. The data will record in micro volt (Jlv). Force Generation will measure by Bio-Analysis Version: 2.2, Advanced Mechanical Technology, Inc. The data will record in Newton.

Administration of test

1.**Backhand Clear**

The Poole Backhand Clear Test

Purpose: To measure the player's ability to hi a backhand clear from his back court high and deep into the opponent's court.

Procedure: One line is drawn parallel to and halfway (61/2 feet) between the short service line and the doubles long service line. Another line is marked 6 inches beyond the back boundary line. A 15-by-15 inch square is drawn 11 feet from the net astride the center. On the other side of the court a 15-by-15-inch square is drawn at the intersection of the doubles long service line and the centre line. Two rackets and preferably twelve shuttles in good condition are needed. A score sheet and some helpers are also needed. The subject stands with his left foot in the x square. He places the shuttle on the forehand side of the racket, tosses it into the air, and then

executes a backhand clear shot deep into the opponent's court. Twelve trials are given.

Scoring: The best ten out of twelve shots are totalled. A perfect score would be forty. Shuttles hitting on the line are given the higher point values. One point is deducted for any shuttle which fails to clear the racket or the player O. Directions:

(a) Most of the pointers listed for the long service test apply also for this test.

(b) The tossing of the shuttle by the subject is a skill that needs some practice.

2. Backhand Drop Shot

Purpose: The purpose of the test is to measure the ability of a player's skill in the Backhand Drop Shot in badminton.

Procedure: Two clothesline ropes is stretched 1 and 2 feet above and parallel to the net. Two rackets and preferably 20 shuttlecocks in good condition is needed for the test. Two dotted lines is marked 1 and 2 feet respectively from the short service line towards the net and parallel to it. Two vertical lines 2 feet from each side-line for singles and parallel to it will draw extending from the short service line up to the net. The tester served high in the backhand side of the rear court between long service line for singles and doubles from the left service court. The players being tested stood towards the centreline in the middle of the left service court and tried to score maximum points by moving towards the shuttle in the rear court and executing backhand drop shot.

Scoring: Score as 5 points; between the first and second rope 3 points; and over the second rope 1-point. The zones will give the point values of five, four, three, two or one in which the shuttle land. The score of each shot will the sum of the net and the floor scores. The score will award according to the point where the base of the shuttle struck the floor. Shuttles falling on a line will award the higher score. Shuttles failing to go over the net going out bounds or falling short of the scoring zones scored no points.

3. Backhand Smash

Purpose- To measure the ability of the player to measure the skill.

Procedure- Divide court in several part with the number of score. The shuttle will be feed by the expert coach. Area of hitting the shuttle will be set before. The

providing points will be 5,4,3,2,1. A 8’3” rope is stretched over the net from where shuttle have to go. When shuttle failed to go through the between this rope it will considered as failed.

Statistical Procedure

For the purpose of the study descriptive statistics, correlation and regression analysis will be employed. All statistical functions will be performed with the SPSS software. The level of significance will be kept at 0.05 to test the hypothesis

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